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Division of Mycology and Disease Survey

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THE PLANT DISEASE REPORTER

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THE PLANT DISEASE SURVEY

DIVISION OF MYCOLOGY AND DISEASE SURVEY

Vol. XX August 15, 1936 Number 15

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OBSERVATIONS ON PLANT DISEASES IN WASHINGTON IN 1936

Leon K. Jones

One month's time (June 15 - July 18, 1936) was devoted to field observations in cooperation with the Extension Department to determine the prevalence of diseases on the more important crops in various areas of the State. A total of 262 disease observations were recorded on the 275 farms visited in the following 21 counties:

1. Chelan
2. Clallam
3. Clark
4. Columbia
5. Cowlitz
6. Grant
7. Grays Harbor
8. Island
9. King
10. Kittitas
11. Klickitat
12. Pacific
13. Pierce
14. San Juan
15. Skamania
16. Snohomish
17. Thurston
18. Wahkiakum
19. Walla Walla
20. Whatcom
21. Yakima

Alfalfa

The state of Washington ranked sixth in the United States in the production of alfalfa in 1934 with a yield of 526,665 tons of hay. The growers in most of the areas visited expressed the view that alfalfa plantings were becoming very short-lived and that after three or four crops had been harvested the stand of plants was generally so poor that the field was no longer profitable. A number of factors probably play a part in the death of plants, including winter injury, Sclerotinia root rot and virus diseases.

Mosaic (virus) was noted abundantly on alfalfa in Walla Walla County a year ago and special emphasis was placed on observations of this disease during the present season. Mosaic was found to be very prevalent in all the alfalfa plantings visited this season in Walla Walla, Kittitas, Chelan, Skamania, Klickitat, Yakima, and Grant Counties. The part played by this disease in the decline of plantings, or methods of control, are as yet unknown; however, there is reason to believe that the disease causes a decline in vigor and possibly is a factor in winter injury of the plants.

Downy mildew (Peronospora trifoliorum) caused considerable damage to some plantings in Kittitas, Pacific, and Skamania Counties, while the common leaf spot (Pseudopeziza medicaginis) disease was noted to greater

or less extent in all the plantings visited. Blotch (Pyrenopeziza medicaginis) was noted abundantly in two fields in Kittitas County.

Apples

Scab (Venturia inaequalis) was fairly abundant in all the counties west of the Cascades, including Skamania County.

Anthracnose (Neofabraea malicorticis) was observed to be very destructive in some orchards in San Juan and Cowlitz Counties.

Beet

Mosaic (virus) was very abundant on seed-beets in Skagit County and in two plantings in Island County that were made with mother-beets brought from Skagit County. Plantings of seed-beeds in Grays Harbor and Island Counties produced from seed were free of mosaic.

Bramble Fruits

Mosaic (virus) was noted on raspberries near Dayton, Walla Walla, Goldendale, and Ellensburg, which increases the prevalence of this disease beyond the distribution reported in Washington Agricultural Experiment Station Bulletin 324. The Dundee, Cumberland, and Ohio varieties of black raspberries in the trial planting at Yelm, Washington, continue to remain relatively free of mosaic and give promise of a possible return of that industry in the area. Mosaic-like symptoms were noted on one percent of the plants in a Lloyd George planting near Sumner which indicates that this variety may not be as resistant to mosaic as originally reported. [Note: See Reporter 20:123-125. Apr. 157.

Septoria leaf spot (Mycosphaerella rubi) was observed to develop destructively on loganberries and youngberries wherever observed in western Washington.

A moderate amount of anthracnose (Elsinoe veneta) was present on black raspberries in Thurston, Cowlitz and Skamania counties.

Western rust (Phragmidium rubi-idaeae) was generally present in western Washington but generally less severe than usual with the possible exception of some areas in King and Clark counties.

Cabbage

Botrytis pod and stem spot (Botrytis sp.), mosaic (virus), and club root (Plasmodiophora brassicae) diseases were observed in Grays Harbor, Clallam, and King counties respectively.

Cherry

Brown rot (Sclerotinia cinerea and S. fructicola) was extremely abundant on cherries in the western part of the State. Sour cherry trees in many areas have been severely damaged by the death of fruiting spurs following attack at blossoming time.

An unusual and destructive development of California peach blight (Coryneum beijerinckii) on sweet and sour cherries was noted in most of the western counties.

Cherry leaf spot (Coccomyces hiemalis) was less abundant than usual but was observed in Snohomish, Whatcom, and King counties.

Scab (Cladosporium carpophilum) which shows as small, circular, diffuse black areas on the fruit was very abundant in most sour cherry orchards.

Buckskin (virus) symptoms of brown spots in the sour cherry fruit was less noticeable this season, which was probably due to the abundance of moisture in the soil. Some observations would lead to the conclusion that trees well fertilized and growing vigorously show less symptoms in the fruit than trees of low vitality.

Iris

Home plantings of Iris in most of western Washington are heavily affected with the disease known as Heterosporium leaf spot (H. gracile).

Lily

Lillies in home gardens in western Washington in most cases showed extreme killing of leaves due to Botrytis blight.

Onion

A blight of onions caused by Botrytis sp. was very damaging to a large planting in Clark County.

Peach

California peach blight (Coryneum beijerinckii) and peach leaf curl (Taphrina deformans) were commonly observed in western Washington and extending into Skamania County.

Pear

Scab (Venturia pyrina) was quite abundant in all western counties.

Pea

Mosaic (virus) was noted of importance in Kittitas, Clallam, King, Snohomish, Thurston, Pierce, Grays Harbor, Pacific, Wahkiakum, Cowlitz, Whatcom, Island, and Klickitat counties.

Fusarium wilt (F. orthoceras pisi) or Fusarium near wilt (F. oxysporum f. 8) were observed in most areas where peas are grown.

Cladosporium spot (C. pisicola) was very abundant in most pea plantings in western Washington. This disease appears to be one of our more important problems on peas in the western part of the State.

Downy mildew (Peronospora viciae) was abundant on the foliage of all plantings observed in western Washington and was damaging pods in Clallam, Grays Harbor, Pacific, and Wahkiakum counties.

Potato

Large plantings of potatoes were observed in Kittitas, Snohomish, Island, Clallam, and Wahkiakum counties. From 5 to 10 percent leaf roll (virus) was commonly noted in plantings made with certified seed. Evidently leaf roll was abundant the previous year and late season infection in the plantings for certification made it difficult to observe and rogue diseased plants.

Rhizoctonia injury to lower stem and roots damaged from 10 to 30 percent of the plants in some fields in Kittitas and Island counties. The affected plants appeared erect with rolled leaves, the stems squarish and heavy with aerial tubers. This trouble was very prevalent in Island County and is known locally as "Crink".

Many home plantings of potatoes were observed and in most cases they were very severely affected with virus diseases: leaf roll, crinkle mosaic, and rugose mosaic.

Prune

Brown rot (Sclerotinia spp.) and California peach blight (Coryneum beijerinckii) have caused considerable spur and limb killing in Clark County.

Gum pocket of prunes, which shows as discolored and gummy areas in the fruit, is an outstanding and serious trouble in Clark and Walla Walla counties. The trouble, in general, is not observed on young, vigorously growing trees, while 100 percent of the fruit on old trees of low vitality often showed gum pocket. Investigational work is needed to determine the exact nature of this trouble. It appears that the vitality of the trees in association with root injury, heart rot of trunk and larger branches, and available nutrition in the soil, are playing an important part in the trouble. There is also reason to believe that this trouble may be directly or indirectly caused by a virus.

Strawberry

Leaf spot (Mycosphaerella fragariae) was observed abundantly in Cowlitz and Clark counties and of slight importance in most other western Washington counties.

Virus troubles are prevalent on strawberries in all the counties visited. The Marshall variety appears to be 100 percent affected with a virus that shows as crinkling and mottling of the foliage with irregular light areas. Young plants and those growing under conditions of high fertility and good moisture content of the soil may show little or no symptoms. Plants suffering from drought or growing in light, low-fertility soil, especially in plantings two or three years old, may show extreme symptoms. This trouble is related to the disease known as crinkle, although a difference of opinion amongst investigators exists and more investigational work is needed before this complex problem can be understood.

Black root is quite prevalent in most of the plantings visited.

Tomato

A few observations on tomato plants in Yakima and Walla Walla counties show that the yellow blight (curly top virus) of tomatoes is somewhat less abundant this season than it has been during the past two seasons. From 10 to 50 percent of the plants in various fields were showing severe symptoms with the lower percentages, in general, showing on plants inter-planted with corn or protected by wind breaks.

Walnut

Winter injury which shows as a death of top branches or nearly entire trees was observed in several counties. Bacterial blight (Bacterium juglandis) was abundant in several plantings in Skamania County.

PLANT DISEASES IN MASSACHUSETTS

O. C. Boyd

Apple scab (Venturia inaequalis) continues to be a factor through July in numerous orchards. The rainy period of June 12, 14, 15, at the time new leaves were expanding on some of the branch terminals, greatly favored secondary infection where leaf or fruit spots occurred in the trees. Lime-sulfur applications were made by some growers during July to burn out foliage infections.

Pear, apple and quince blight (Bacillus amylovorus) was showing up generally over the State by the first of the month, as twig and branch die-back, apparently resulting from the favorable infection period of June 12, 14, 15. It is worse than in most past years, and follows very light blossom and early twig infection.

Potato late blight (Phytophthora infestans) was first reported by county agent Charles Harris from Dartmouth and Westport in Bristol County. He observed it on July 8, and considered it to have been discernible at least a week earlier. The rainy period of June 12, 14, 15, followed by frequent fogs that came in from the ocean, apparently gave it a start. By July 15, the disease had caused heavy defoliation in both Cobbler and Green Mountain on one farm where only one spray had been applied, and was present as light infections in many fields of those two towns. The well sprayed fields showed only traces or none of the disease. There was evidence that the disease started earlier and made most headway in fields where potatoes blighted down last year.

A tomato bacterial canker (Aplanobacter michiganse) specimen was sent in from Plymouth County on July 21, the first occurrence in the field I have a record of this year.

Bean bacterial blight (Bacterium spp.) began to show up generally around the middle of July, not only in green snap beans, but limas and the French Horticultural shell bean. It appears to be most pronounced in the Horticultural beans, of which many growers save their own seed.

Bean rust (Uromyces phaseoli) was first observed on July 21 in Amherst. It usually appears about that time of year, and sometimes causes heavy losses to pole beans in wet seasons.

Corn bacterial wilt (Stewart's Disease due to Aplanobacter stewarti) has been observed in only one field this year, a three-acre field of popcorn in Hampden County planted with seed grown in the same town in 1934. Corn had not been grown in that field in recent years. The disease was just showing up on July 23 as primary infection scattered more or less uniformly over the entire field. The crop was in early tassel stage; and it was estimated that about 0.5 percent of the hills were affected.

Elm wilt due to Cephalosporium was observed in Worcester on July 8. The fungus was determined by Dr. Malcolm McKenzie. (Massachusetts Agricultural Experiment Station. Aug. 1).

A CONIOTHYRIUM DISEASE OF PEONIES

M. R. Harris

During March 1932 a blight of peonies was observed in two nurseries in the San Francisco Bay region. The disease attacked tree peonies, causing a wilting and killing of the flower stems. It seemed to affect the flowering plants at a rapid rate and the Japanese gardeners know it as the "sudden death disease". Later the trouble was found in Sacramento and Santa Clara. Under field conditions it was observed only on tree peonies. Specimens were received at the California State Department of Agriculture plant pathological laboratory where the cause of the killing was determined.

Symptoms of the Disease

The wilting of the flowers was brought about by a girdling of stems at the base. At first a slight darkening of the tissue on the stem surface was noticeable. Within twenty-four hours this had become a deep brown and had extended up the stem for two or three inches. Following this the whole stem wilted rapidly. Many times the flowers were in full bloom when wilting occurred. On other stems, the flower buds were affected. Frequently, young buds, just ready to open would become slightly water soaked in appearance and rapidly become brown. The enclosed petals of the flower would then dry out and become quite brittle. Usually such buds remained on the plant and did not fall to the ground.

On plants which were attacked after the flowering stage was completed, the fungus caused a browning condition and a sharply zonate effect. This type of injury occurred only on the more mature stems and affected only the outer surface layer of cells. Leaves on such stems were sometimes killed but many were not injured and continued to function. The zonate phase of the disease did not seem to cause much injury to the plant.

Varietal Susceptibility

Under natural conditions the disease has been found only on tree peonies (Paeonia Moutan). This species, in the San Francisco Bay region, is affected by all phases of the disease. The zonate form has been observed on this species in Sacramento, where climatic conditions differ from the Bay region in being much warmer and drier during most of the growing season for peonies. The other more destructive phases have not been observed in Sacramento. No natural infection has been found on herbaceous peonies (Paeonia albiflora). However, under greenhouse conditions, this species has been repeatedly infected and if exposed to inoculum of the fungus under moist conditions is as susceptible as the tree peonies.

Organism Associated with the Disease

Portions of the diseased tree peony plants were cultured on potato-dextrose agar and a fungus of the genus Coniothyrium was consistently isolated. This fungus, on potato-dextrose agar, produced pycnidia within three weeks of the time the cultures were made. These pycnidia were filled with masses of spores. By crushing the pycnidia in distilled water a heavy spore suspension was made. This was used to inoculate herbaceous peonies, since no tree peonies were available at the time. The plants were inoculated by first pricking the lower parts of the stem with a sterile needle and then atomizing the spores over the wounded areas, or by spraying the growing tips with the spore suspension. In both types of inoculation the plants became diseased, and all of the ten inoculated plants showing symptoms identical with those on tree peonies.

The fungus was recovered from diseased tissue and carried on potato-dextrose agar. It was again used to inoculate a series of herbaceous peony plants. Altogether eighteen plants were inoculated and two were held as checks. Both check plants and inoculated plants were injured with a sterile needle at the base of the stem just above ground line. A spore suspension of the fungus was sprayed in large amounts over the inoculated plants with an atomizer. Of the plants treated all were infected and, while no special effort was made to infect growing tips, fifteen out of the eighteen plants showed tips killed by the fungus. The symptoms were identical with those obtained on the first ten plants inoculated. These plants were held for several months following the inoculation and killing of the plants. When examined at the end of this time they were found to have numerous pycnidia over the surface of the inoculated area. When the pycnidia were viewed under a microscope they were found to contain a large number of spores.

While making a study of the fungus it was noted that it resembled the fungus Coniothyrium fuckelii Sacc. which commonly causes stem canker

on roses in California. A culture of C. fuckelii was isolated from roses and used to inoculate a single tree peony plant. Very rapid killing resulted and the fungus was recovered in pure culture from the diseased tissue. Cultures of the fungus isolated on tree peonies were carefully studied and found to compare quite closely with Coniothyrium fuckelii Sacc. Further studies are being made but it is believed that the fungus found on peonies is identical with that causing stem canker of roses.

Control of the Disease

The control of the disease is difficult where the infestation is heavy. The disease has been eliminated from lightly infested peony plantings where only a few plants were diseased. Under such conditions all infested plants were dug up and burned. It is believed to be essential that all Coniothyrium affected rose plants growing near peony plantings be destroyed. In one nursery, inspected during this study, there was strong evidence to support the belief that the tree peonies were infected from a row of diseased rose bushes. Where the disease is found, it has been shown that an application of 3-3-50 Bordeaux spray will reduce the number of new infections. Control of the disease can be accomplished by destroying all infected peony plants; by eliminating all rose bushes carrying the disease; and by spraying with 3-3-50 Bordeaux for a short time immediately after all known infective material has been destroyed. Freshly cut stems should be coated with a substance toxic to spores of the fungus and pruning shears should be sterilized frequently during pruning operations.

Detailed inoculation and histological studies on tree peonies are in progress. (California State Department of Agriculture).

A DISEASE OF PANDANUS IN ALABAMA

Dr. G. W. Carver, of the Tuskegee Institute in Alabama, sent a specimen of Pandanus javanicus variegatus attacked by Diplodia natalensis. He writes that one large plant, with stalks nearly two-and-a-half inches in diameter, was killed by the fungus.

The Survey has no other record of the fungus on Pandanus.

A ROOT INFECTION OF PLUMS IN NEW JERSEY

R. P. White

Recently several plums being used for ornamental purposes have been examined in an attempt to diagnose the cause of their death. These particular trees were several years old and had been infected with black knot for some time. In addition to this disease, several large limbs and numerous smaller ones had been removed in previous years indicating the die-back disease caused by Valsa leucostoma.

At the time of examination, the foliage over the entire specimen was sparse, small, yellowish and red. The entire aspect of the trees was one to indicate approaching death. One of the specimens was found to be loose in the soil, but another was firm, due, it was found later, to deep planting, the first roots being about fourteen inches below the surface of the lawn. The soil about the roots of the first tree was excavated carefully and the roots examined. All the smaller roots were dead and mostly in an advanced stage of decay. The wood of the larger roots was reddish-brown in color, deepening to dark brown as they approached the trunk, and fading out to apparently healthy tissue two feet away from the trunk. The brown discoloration extended into the lower portions of the bole, and extended upward above the soil level. Under the loosened bark on one side, white fans of fungous growth were present, but whether these were connected with the cause of the root rot could not be determined.

Roots varying from slightly to severely invaded, were taken from the soil and on the flattened under-surface of one, numerous black beaks of perithecia were protruding in groups. Laboratory examination of perithecia and spores supported the field assumption that the fungus was Valsa leucostoma.

While this fungus has been known for a long time as associated with a die-back disease of stone fruits, no reference to its causing a root and crown infection has apparently been made. The condition of the trees examined would indicate that die-back has been present on these specimens for several years and it is assumed that Valsa leucostoma was associated with it. (From New Jersey Agricultural Experiment Station, Department Plant Pathology, Nursery Disease Notes, Vol. 9, No. 1, July 1936.)

DUTCH ELM DISEASE ERADICATION

Dutch elm disease was found on six trees, during the first week in July, in Indianapolis. This brings to eight, the total number of confirmed trees in Indianapolis thus far this summer.

One confirmed tree has been reported from the town of Ridgefield, Fairfield County, Connecticut. This is the first case of the disease in Ridgefield. On July 7 the first confirmation of a tree in the Old Lyme, Connecticut, area was reported. Two confirmed trees have been found in the town of Westport, Connecticut. The only previously diseased tree in Westport was a single case found in 1935. The number of confirmed and removed trees, as shown by weekly reports of the Bureau of Entomology and Plant Quarantine from June 28 to August 1 inclusive, are as follows:

	Connecticut	New Jersey	New York	Outside	Total
June 28 to August 1					
Trees confirmed	39	2,414	821	17	3,291
Trees removed	39	1,388	726	6	2,159
Total to August 1					
Trees confirmed	199	12,523	5,965	77	18,764
Trees removed	197	10,949	5,615	66	16,827

SORESHIN OF TOBACCO IN KENTUCKY

E. M. Johnson

Soreshin was seen in a field of dark fire-cured tobacco in Logan County, Kentucky, on July 22, 1936. The tobacco was set early in May and was about two-thirds grown. The season has been very hot and the rainfall much below normal.

Four percent of the plants were dead or dying, however, in areas of the field 25 percent of the plants were affected. The first symptom of the disease was wilting of one or more tip or middle leaves. On these plants, brown to almost black lesions, one-half to one and one-half inches in diameter, were found at or a little above the soil level. These young lesions usually extended to and slightly discolored the outer portion of the pith next to the lesion. In later stages of the disease the stem was girdled and dead for a distance of six to eight inches above the crown or soil level. Where the stem was completely dead the pith was latticed. At the outer border of the dead area the pith was discolored only. On girdled plants four to eight lower leaves were either dead, affected with a moist rot, or wilting badly. The roots appeared normal except when the plants were dead. A Rhizoctonia was isolated from young lesions.

The same disease was observed in two fields, a dark air cured and a dark fire-cured, in Todd County and in another field of dark air cured in Logan County. Only a few plants were affected in these fields. (Kentucky Agricultural Experiment Station, Aug. 10).

WEATHER CONDITIONS AND BACTERIAL WILT OF CORN IN MICHIGAN AND INDIANA

Neil E. Stevens

Where direct experiment is difficult or impossible, establishing even reasonably reliable correlations between weather conditions and the incidence of plant disease is, to a considerable extent, a matter of trial and error. It is then natural that differences of opinion frequently arise. Illustrative of this are the different explanations offered for the sharp recession in the amount of bacterial wilt (caused by Aplanobacter stewarti) of sweet corn in 1934 as compared with 1933. This is summarized in The Plant Disease Reporter, Supplement 90, December 31, 1935, on page 30, as follows:

"The recession in distribution and severity was attributed in the northeastern sections to the cold winter, and in Indiana and Michigan to the dry spring which appeared unfavorable for the spread of the disease."

With the reports for 1935 now on hand, it is possible to check somewhat further the relation in Michigan and Indiana. The estimated losses due to the disease for the two States, from 1931 to 1935, are given in Table 28.

Table 28. Estimated reduction (percent) in yield of sweet corn due to bacterial wilt (Aplanobacter stewarti), in Indiana and Michigan, 1931-35.

	1931	1932	1933	1934	1935
Indiana	1	20	10	5	5
Michigan	0	15	6	3	Trace

The rainfall data for these years for the months June to August at Lansing, Michigan and Lafayette, Indiana, are summarized in Tables 29 to 32, inclusive. These stations are chosen as being fairly representative of the states as a whole and are the central points from which observations on the incidence of the disease were made.

A comparison of the tables shows that while May and June 1934 were relatively dry, this was not the case in 1935. Actually, the rainfall for May and June was above normal at both Lansing and Lafayette.

Table 29. Rainfall in inches at Lansing, Michigan, during May, June, July, and August, 1931-35.

Year	Rainfall in inches			
	May	June	July	August
1931	3.71	3.73	0.92	1.70
1932	5.03	1.24	3.44	3.71
1933	3.95	2.56	1.43	2.14
1934	1.33	1.67	2.14	1.51
1935	3.88	4.95	2.60	2.69

Table 30. Days with .01 inch or more rain at Lansing, Michigan, during May, June, July and August, 1931-35.

Year	Number of days with .01 inch or more rain			
	May	June	July	August
1931	14	12	7	7
1932	12	8	8	12
1933	17	9	6	7
1934	6	7	5	6
1935	12	14	7	9

Table 31. Rainfall in inches at Lafayette, Indiana, during May, June, July, and August, 1931-35.

Year	Rainfall in inches			
	May	June	July	August
1931	2.29	3.39	0.90	7.89
1932	2.04	2.56	3.40	3.88
1933	6.97	0.32	2.38	1.64
1934	0.40	1.96	1.90	5.09
1935	5.25	6.54	5.49	2.87

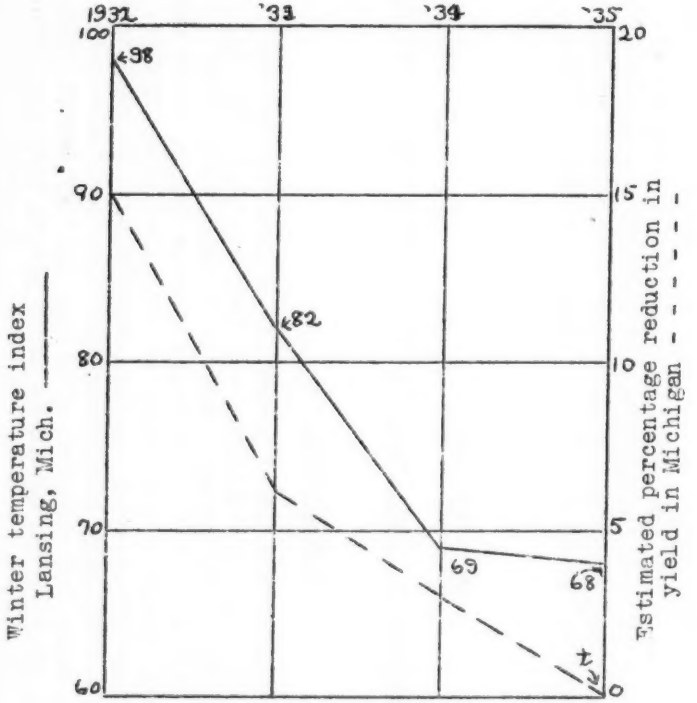


Figure 40. Estimated reduction in yield of sweet corn due to bacterial wilt in Michigan for the years indicated and indices for the preceding winters at Lansing.

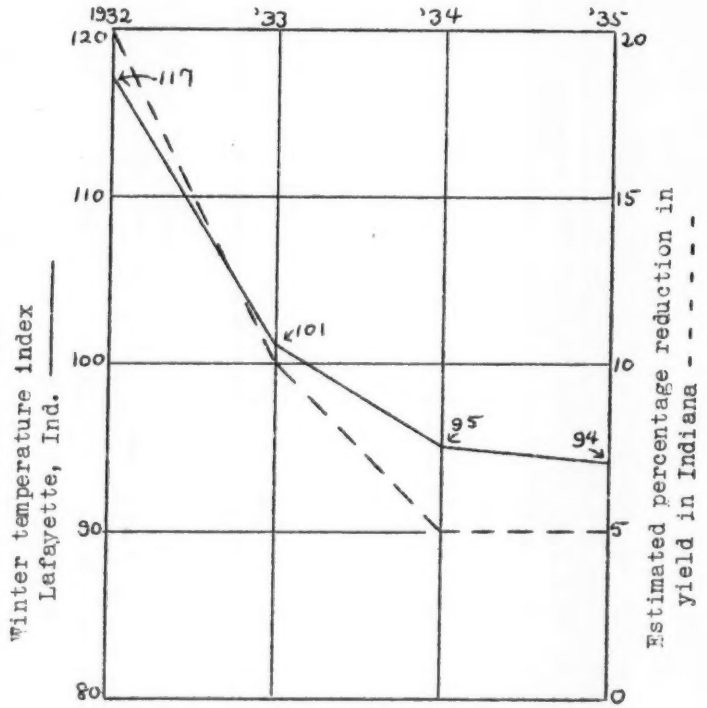


Figure 41. Estimated reduction in yield of sweet corn due to bacterial wilt in Indiana for the years indicated and indices for the preceding winters at Lafayette.

Table 32. Days with .01 inch or more rain at Lafayette, Indiana, during May, June, July, and August, 1931-35.

Year	Number of days with .01 inch or more rain			
	May	June	July	August
1931	11	12	4	10
1932	9	10	8	8
1933	18	3	4	6
1934	5	7	5	11
1935	15	16	10	9

There was, however, no corresponding increase in the amount of bacterial wilt in 1935. In fact, Michigan reported a continued decrease (see Table 28), and although the percentage loss for Indiana is given as the same, the regular report sent in to the Plant Disease Survey indicates this disease in 1935 as being "less prevalent than last year".

On the other hand, the correlation between the temperature of the preceding winters at the stations indicated and amount of loss from bacterial wilt reported from the states as a whole, as indicated in Figures 40 and 41, is rather close. For the years in question, the amount of loss from bacterial wilt of corn in Michigan and Indiana was during this period apparently more closely correlated with the temperatures of the preceding winter, than with spring rainfall. (Department of Botany, University of Illinois.)

JULY WEATHER

(From Weekly Weather and Crop Bulletin for the week ending August 4, 1936.)

THE DROUGHT

July was extremely hot and dry throughout the interior of the country. Figure 42 shows that considerable sections had less than 10 percent of normal rainfall. Preliminary reports in more detail than carried on this chart indicate that, on a State average basis, there was less than half of normal (usually much less) in the Ohio Valley States, the Lake region, the upper Mississippi Valley, and throughout the Plains from Oklahoma northward. The only exceptions over this vast territory are Kentucky and Ohio, which had somewhat more than half of normal rainfall. The States from Oklahoma northward to North Dakota had only from

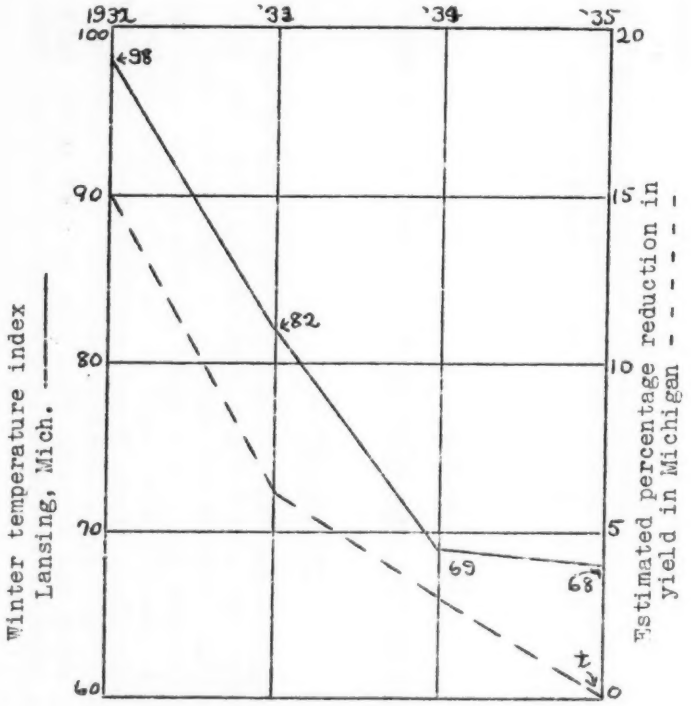
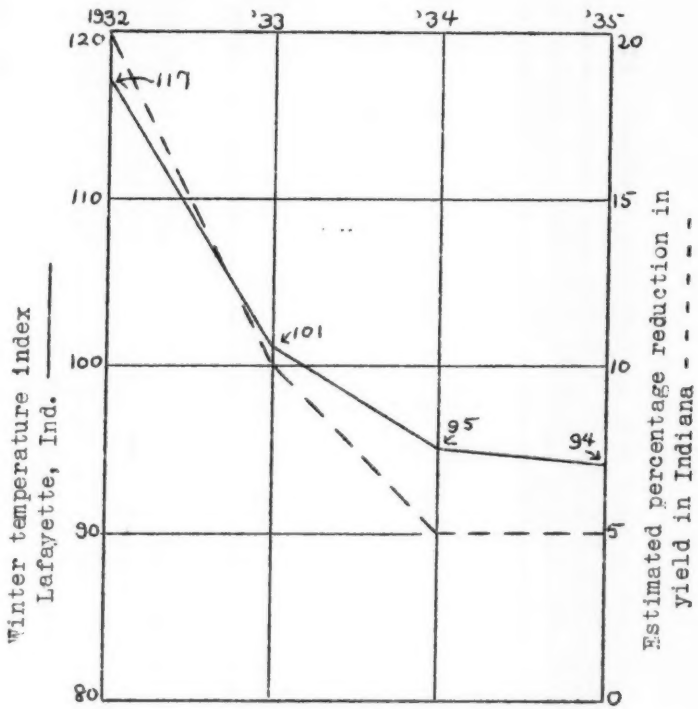


Figure 40. Estimated reduction in yield of sweet corn due to bacterial wilt in Michigan for the years indicated and indices for the preceding winters at Lansing.



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On the other hand, the correlation between the temperature of the preceding winters at the stations indicated and amount of loss from bacterial wilt reported from the states as a whole, as indicated in Figures 40 and 41, is rather close. For the years in question, the amount of loss from bacterial wilt of corn in Michigan and Indiana was during this period apparently more closely correlated with the temperatures of the preceding winter, than with spring rainfall. (Department of Botany, University of Illinois.)

JULY WEATHER

(From Weekly Weather and Crop Bulletin for the week ending August 4, 1936.)

THE DROUGHT

July was extremely hot and dry throughout the interior of the country. Figure 42 shows that considerable sections had less than 10 percent of normal rainfall. Preliminary reports in more detail than carried on this chart indicate that, on a State average basis, there was less than half of normal (usually much less) in the Ohio Valley States, the Lake region, the upper Mississippi Valley, and throughout the Plains from Oklahoma northward. The only exceptions over this vast territory are Kentucky and Ohio, which had somewhat more than half of normal rainfall. The States from Oklahoma northward to North Dakota had only from

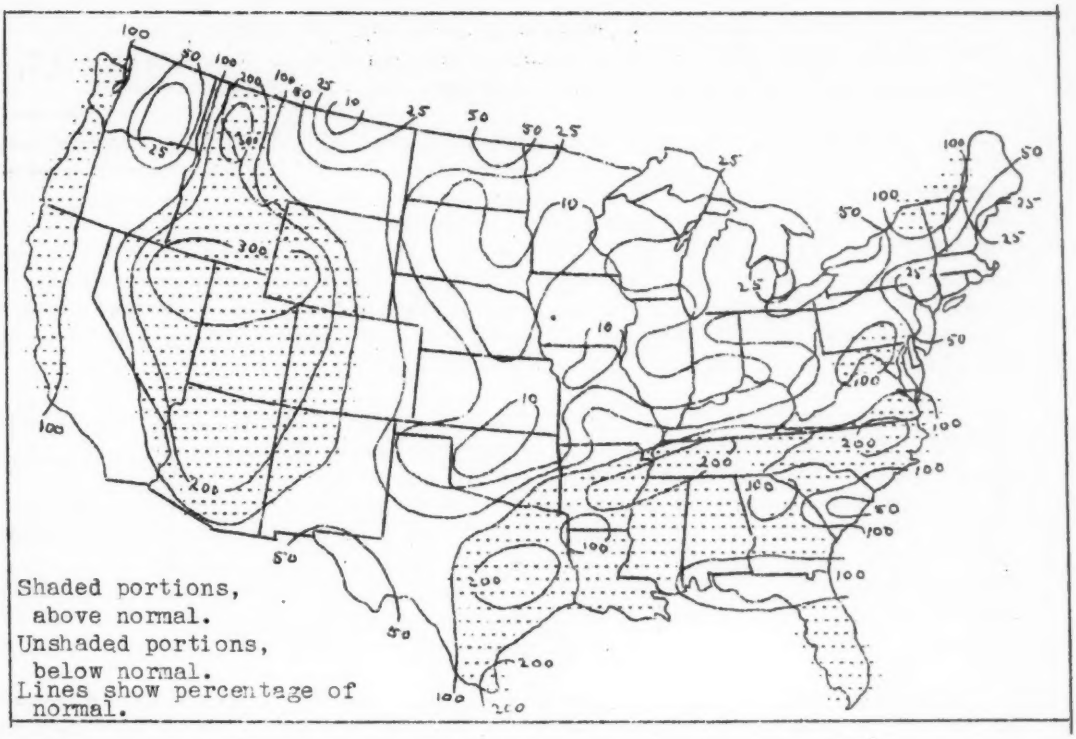

Figure 42. Percentage of Normal Precipitation for July 1936.

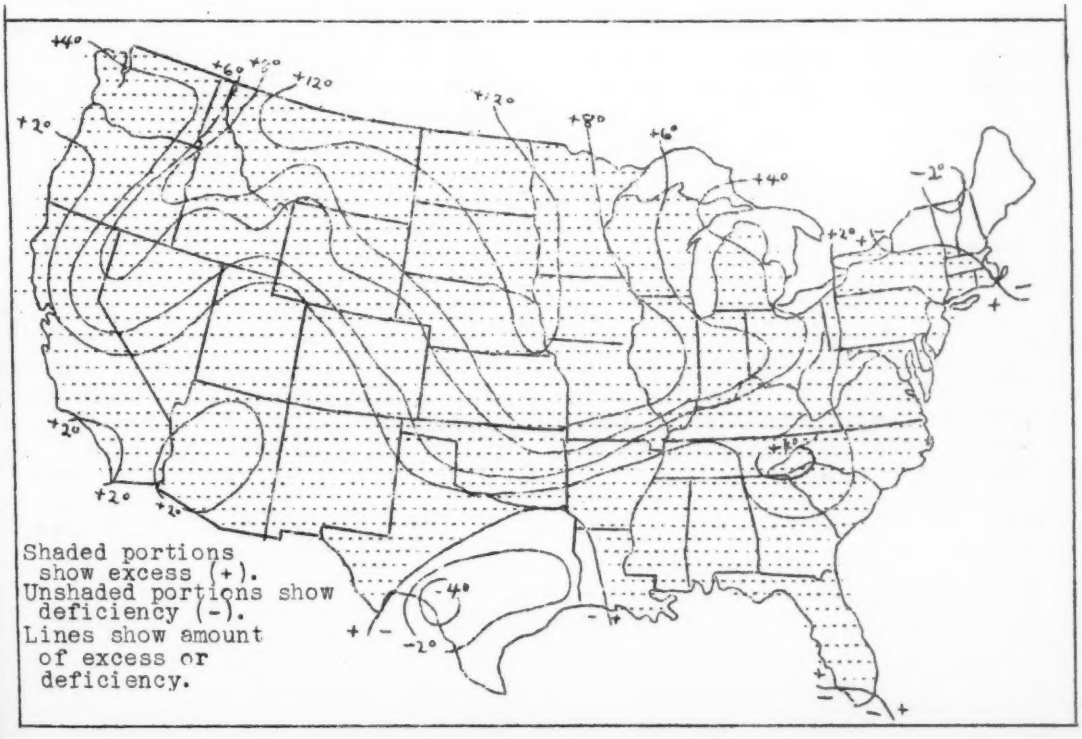

Figure 43. Departure of Mean Temperature from the Normal for July 1936.

20 to 36 percent of normal; Minnesota had about 20 percent, and Iowa less than 15 percent. July 1936 was drier than July 1934 in every State from Kentucky, Missouri, and Oklahoma northward to the Canadian border.

Figure 43 shows that the month was also extremely hot; the hottest July of record in Kentucky, Iowa, Minnesota, Nebraska, the Dakotas, and Montana, and about equal to the previous high-temperature records in Missouri and the northern Ohio Valley States. The average temperature for the month exceeded by far the previous high record in a large central-northern area. At Des Moines, Iowa, it was about 3° higher than for any previous July; 4° higher at Sioux City, Iowa; 5° higher at Rapid City, South Dakota., Miles City, Montana, and Williston, and Devils Lake, North Dakota, and 6° higher at Bismarck, North Dakota, and Havre, Montana.

JUNE AND JULY The months of June and July combined had an average of only about one-third of normal rainfall in the Plains States and around 40 percent of normal in the western Ohio and middle Mississippi Valleys. In the interior States the two-month period was much drier than the same two months during the great drought of 1934. In that year, for these two months, Missouri had about 30 percent more rainfall; Ohio, Kansas, Nebraska, and Montana about 50 percent more; Indiana, Illinois, Wisconsin, and North Dakota about twice as much; Minnesota and Iowa considerably more than twice as much, and South Dakota nearly three times as much rain as fell this year.

THE GROWING SEASON TO DATE. The four months of the growing season so far this year--April to July--with records for April, May, and June complete, and preliminary reports for July, indicate that the season has been the driest of record in the Dakotas, Minnesota, Wisconsin, Iowa, Missouri, Illinois, and Indiana, and the second driest in Ohio, Kentucky, Oklahoma, Kansas, and Montana. Of the Central and Northern States between the Appalachian and Rocky Mountains only Michigan, Kansas, and Nebraska were drier in 1934 than this year for these four months; in North Dakota, in 1934, there was 60 percent more rainfall than this year.

From the above summaries it is evident that the drought in the interior of the country this year is measurably more severe than any other of record in the climatological history of the country.

In the severe drought year of 1934 a sizable area in the upper Mississippi Valley did not suffer materially at any time, and by the middle of August, or soon thereafter, drought conditions were materially relieved in Missouri, the Ohio Valley States, Minnesota, and Wisconsin, but the Plains had no general relief until early in September. During September nearly all interior States of the country had substantially more than normal rainfall.